was equally unsuccessful in procuring that acid in a pure form by the other processes usually had recourse to. It was either combined with minute portions of tan, or, when obtained by sublimation, was empyreumatically tainted.

In conclusion, it is remarked, that the Chinese galls differ from other analogous vegetable substances in the absence of extractive matter, whence they may be regarded as the most promising source of pure tan and gallic acid; that the same circumstance renders them peculiarly fitted for the basis of a black dye, and of writing-ink, while it at the same time renders them ill calculated for the production of leather, which without extractive matter is brittle and imperfect.

Some Researches on Flame. By Sir Humphry Davy, *LL.D. F.R.S. V.P.R.I.* Read January 16, 1817. [*Phil. Trans.* 1817, *p.* 45.]

This communication is subdivided into four sections, of which the first treats of the effect of rarefactions of the air, by diminished pressure, upon flame, and explosion. An inflamed jet of hydrogen was placed in the receiver of an air-pump, and the flame was observed to enlarge during exhaustion, till the gauge indicated a pressure of one fourth or one fifth; it then diminished in size, but was not extinguished till the pressure was reduced to between one seventh and one eighth. A somewhat larger jet burned until the rarefaction amounted to one tenth, and rendered the glass tube whence the gas issued white hot. To this circumstance the author refers the long-continued combustion of the gas, and thinks the conclusion confirmed by the following experiment. A platinum wire was coiled round the jet tube, so as to reach into and above the flame, and it became white hot during the exhaustion, and continued red hot even when the pressure was only one tenth. The lower part of the flame was now extinguished, but the upper part in the contact of the wire continued to burn till the pressure was reduced to one thirteenth. The flame, therefore, of hydrogen is extinguished in rarefied atmospheres, whenever the heat it produces is insufficient to communicate visible redness to platinum wire. Sir Humphry Davy was thus led to infer, that those combustibles which require least heat for combustion would burn in rarer atmospheres than those requiring more heat; and that bodies which produce much heat in combustion would burn in rarer air than those producing little heat, and experiments are detailed proving this to be the case: thus, an inflamed jet of light carburetted hydrogen, which produces little heat in combustion, and requires a high temperature for its ignition, was extinguished whenever the pressure was below one fourth, even though the tube was furnished with a wire. Carbonic oxide burned under a pressure of one sixth; sulphuretted hydrogen of one seventh. Sulphur, which burns at a lower temperature than any other ordinary combustible, except phosphorus, had its flame maintained in an atmosphere rarefied 15 times, and phosphuretted hydrogen was inflamed when admitted into the best vacuum of an excellent air-pump.

The author next proceeds to consider the influence of rarefaction, produced by heat, upon combustion and explosion. A volume of air at 212° is expanded to 2·25 volumes. At a dull red heat its probable temperature then is 1032°, provided it expand equably for equal increments of heat.

M. Grotthus has concluded that expansion by heat destroys the explosive powers of gases, but Sir H. Davy found that two parts of oxygen and one of hydrogen expanded to 2·5, its original bulk, detonated at a red heat, and in another experiment, even at a lower temperature; whence it appears, that detonating gaseous mixtures have their inflammability rather increased than diminished, by expansion by heat. In prosecuting these inquiries, the author discovered that a mixture of oxygen and hydrogen produced water at a temperature below visible redness, and without explosion or even any luminous appearance; and at a temperature a little above the boiling point of quicksilver, charcoal converts oxygen into carbonic acid without any of the ordinary phænomena of combustion.

The third section relates to the effect of the mixture of different gases upon explosion and combustion. When 1 part of a mixture of oxygen and hydrogen, in the proportions that form water, is mixed with 8 parts of pure hydrogen, the electric spark does not inflame the mixture; and its combustion is similarly prevented by 9 parts of oxygen, 11 of nitrous oxide, 1 of carburetted hydrogen, 2 of sulphuretted hydrogen, 0·5 of olefiant gas, 2 of muriatic acid gas, and five sixths of silicated fluoric acid gas. It therefore appears that other causes, besides density and capacity for heat, interfered in these phenomena; for nitrous oxide, which is one third denser than oxygen, and which has a greater capacity for heat, has lower powers of preventing explosion; and hydrogen, though fifteen times lighter than oxygen, has a higher power of preventing explosion; and olefiant gas, in this respect, precedes the others in an infinitely higher ratio than could have been expected either from its density or capacity.

The author concludes this paper with some general observations, and practical inferences founded upon the previous detail of facts. Flame may be regarded as gaseous matter, of a temperature above that which is capable of giving to solids a white heat; for heated air, though not luminous, will communicate that high temperature to solid bodies. When we attempt to pass flame through fine wire gauze, the metal so far cools the gaseous matter that it is no longer luminous. The power of metallic and other tissues to prevent the combustion of explosive gaseous mixtures, will depend upon the heat required for their combustion, as compared with that acquired by the tissue; and the flame of those bodies which are most readily inflammable, and of those which produce most heat in combustion, will pass through a wire gauze capable of intercepting those flames that produce little heat; so that the flames of different substances will pass through wire gauze at different temperatures. For instance, a tissue that has 100 apertures in the square inch will intercept the flame of alcohol, but not that of hydrogen; and a tissue which would

not intercept an explosion from olefiant gas, would prevent it with fire-damp.

The combustibility of different gases is, to a certain extent, in direct proportion to the masses of heated matter required to inflame them. A red-hot wire, one fortieth of an inch in diameter, will not ignite olefiant gas, but it will inflame hydrogen gas; and the same wire heated white-hot, will inflame olefiant gas, but will not inflame the carburetted hydrogen of the coal-mines, which fortunately is the least combustible of the inflammable gases. The cooling power of metal, in regard to flame, is well shown by encircling a very small flame with a cold iron wire, which instantly causes its extinction. The interruption of the flame, therefore, in the author's safety-lamp, depends upon no recondite cause, but is simply referable to the cooling power of the wire-work tissue.

From the facts contained in the first part of this paper, the author conceives that the light of meteors depends not upon the ignition of inflammable gases, but upon that of solid bodies; that such is their velocity of motion, as to excite sufficient heat for their ignition by the compression even of rare air; and that the phenomena of falling stars may be explained by regarding them as small incombustible bodies moving round the earth in very excentric orbits, and becoming ignited only when they pass with immense rapidity through the upper regions of the atmosphere; while those meteors which throw down stony bodies, are similarly circumstanced, combustible masses.

Some new Experiments and Observations on the Combustion of gaseous Mixtures; with an Account of a Method of preserving a continued Light in Mixtures of inflammable Gases and Air without Flame. By Sir Humphry Davy, *LL.D. F.R.S. V.P.R.I.* Read January 23, 1817. [*Phil. Trans.* 1817, *p.* 77.]

Having shown, in a former communication, that the temperature of flame is considerably greater than that required for the ignition of solid bodies, the author thought it probable that, during the combination of certain gaseous substances, the heat evolved might be adequate to the incandescence of solid matters exposed to them, though insufficient to render the gases themselves luminous, or, in other words, to produce flame.

In a combustible mixture of coal-gas and air, the author suspended a small wire-gauze safe-lamp, in which some fine platinum wire was fixed above the flame; and when the inflammation had taken place within the cylinder of gauze, the quantity of coal-gas was increased, under the idea that the heat acquired by the mixed gas in passing through the wire gauze would prevent the excess from extinguishing the flame. When this happened, the wire of platinum continued to glow, though there was no inflamed gas in the cylinder; so that the oxygen and coal-gas in contact of the wire seemed to burn without flame, and yet produced heat enough to keep the wire ignited. This conclusion was verified by introducing a hot platinum wire into a